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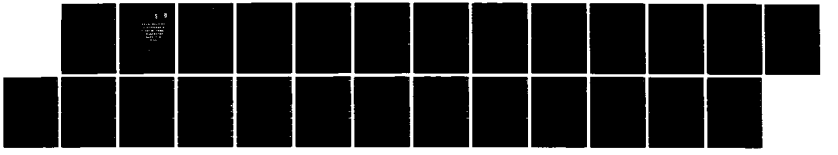

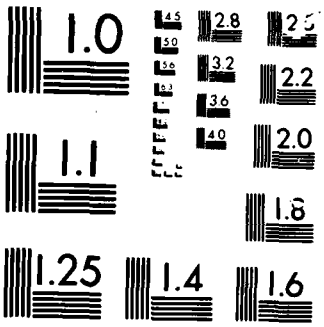
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NAVAL WEAPONS STATION EARLE FLEET MOORINGS UNDERWATER INSPECTION PLAN

31 MARCH 1983

OCEAN ENGINEERING
AND CONSTRUCTION PROJECT OFFICE
CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON, D.C. 20374

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As part of the COMNAVFACENGCOM's Fleet Mooring Maintenance (FMM) Program, CHESNAVFACENGCOM has been assigned the responsibility for the conduct of underwater inspections of fleet moorings worldwide. This plan provides guidelines for the underwater inspection of five fleet moorings (Con't)

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operated and maintained by the Naval Weapons Station Earle, Colt's Neck, New Jersey. This inspection is scheduled to take place in the early April 1983 time frame.

CHESNAVFACENGCOM has designated an Engineer-in-Charge (EIC) to provide on-site technical guidance to the Underwater Construction Team One (UCT ONE) divers who will actually perform the underwater portion of the inspection and collect the data. In addition, the EIC will prepare the post-inspection report which will include the results of the inspection and recommendations for required maintenance actions.

FLEET MOORING INSPECTION PLAN

NAVAL WEAPONS STATION EARLE

APRIL 1983

OCEAN ENGINEERING AND CONSTRUCTION
PROJECT OFFICE

CHESAPEAKE DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
WASHINGTON D.C. 20374

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Officer in Charge
UCT ONE

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NWS EARLE UNDERWATER INSPECTION PLAN

1.0 BACKGROUND

As part of the COMNAVFACENGCOM's Fleet Mooring Maintenance (FMM) Program, CHESNAVFACENGCOM has been assigned the responsibility for the conduct of underwater inspections of fleet moorings worldwide. This plan provides guidelines for the underwater inspection of five fleet moorings operated and maintained by the Naval Weapons Station Earle, Colt's Neck, New Jersey. This inspection is scheduled to take place in the early April 1983 time frame.

CHESNAVFACENGCOM has designated an Engineer-in-Charge (EIC) to provide on-site technical guidance to the Underwater Construction Team One (UCT ONE) divers who will actually perform the underwater portion of the inspection and collect the data specified in paragraph 4.0. In addition, the EIC will prepare the post-inspection report which will include the results of the inspection and recommendations for required maintenance actions.

2.0 PROJECT RESPONSIBILITIES

CHESNAVFACENGCOM will develop the FM underwater inspection plan, provide technical assistance to the dive team, prepare the required inspection forms, evaluate the observed inspection data, and report the results of the inspection to interested activities.

UCT-1 will provide sufficient divers to accomplish the inspection within the allotted time frame, ensure that the required amount of diving support material/equipment is available, and that all desired data is gathered and accurately reported.

The activity responsible for the moorings being inspected will provide logistic support as required by the Engineer-in-Charge and the UCT dive team.

3.0 GENERAL MOORING HISTORY

NWS Earle normally operates and maintains five fleet moorings. About three months ago, two of the mooring buoys were entrapped in winter ice, apparently suffered hull punctures, and were sunk. These buoys were subsequently located, raised, and moved ashore for repairs.

The NWS Earle moorings are modified riser-type E class moorings and each is located within a quarter of a mile to the east of Piers 1 and 2 in relatively shallow water (approximately 18 feet). Figure 1 is an as-built drawing of each of the mooring systems. Each mooring is utilized about 200 days per year, primarily by barges. The moorings were last overhauled during the summer of 1978 and recent station periodic maintenance has revealed numerous discrepancies, probably due to the ages of the mooring systems.

4.0 INSPECTION PROCEDURES

4.1 Inspection Objectives. The purpose of mooring inspections is to determine the general physical condition of buoys and chain assemblies and, when possible, to verify or update existing as-built and maintenance records. Divers inspect only a portion of the submerged buoy hull and chain assemblies in order to compile a general description of the mooring's condition. The existence of fairly consistent measurements during this inspection provides a good indication of the mooring's overall condition. It should be kept in mind that periodic underwater inspections are intended as an expedient and relatively inexpensive supplement to accurate maintenance records. As such, they cannot fully substitute for a complete inspection involving recovery of the mooring and the measurement and evaluation of each component.

One of the more important parameters used to evaluate the condition of a mooring is chain wire diameter. After cleaning to bare metal, a selective sampling of the wire diameter of chain links and connecting hardware is taken in order to determine the amount of deterioration due to corrosion and wear. "Single Link" measurements are taken where chain is slack, and detect only corrosion loss. "Double Link" measurements, taken where two links connect under tension, detect the combined effects of corrosion and wear. Chain links and other components which measure 90% or greater of original wire diameter are considered to be in "good" condition; measurement between 80% and 90% of original diameter is considered "fair" condition and is cause for the mooring to be downgraded in classification; any measurement less than 80% is considered "poor" and is cause for the mooring to be declared unsatisfactory for fleet use. Figure A-1 in Annex A depicts the proper method of taking both single and double link measurements.

Standard underwater inspection procedures do not call for the inspection of any part of the mooring which is buried. Ground legs and risers are observed only to the point at which they become buried; no attempt is made to locate and inspect anchors or other mooring materials which are not readily visible.

The following paragraphs contain the general inspection procedures that will be followed. For clarification, a schematic drawing of a typical riser-type mooring is shown in Figure 2.

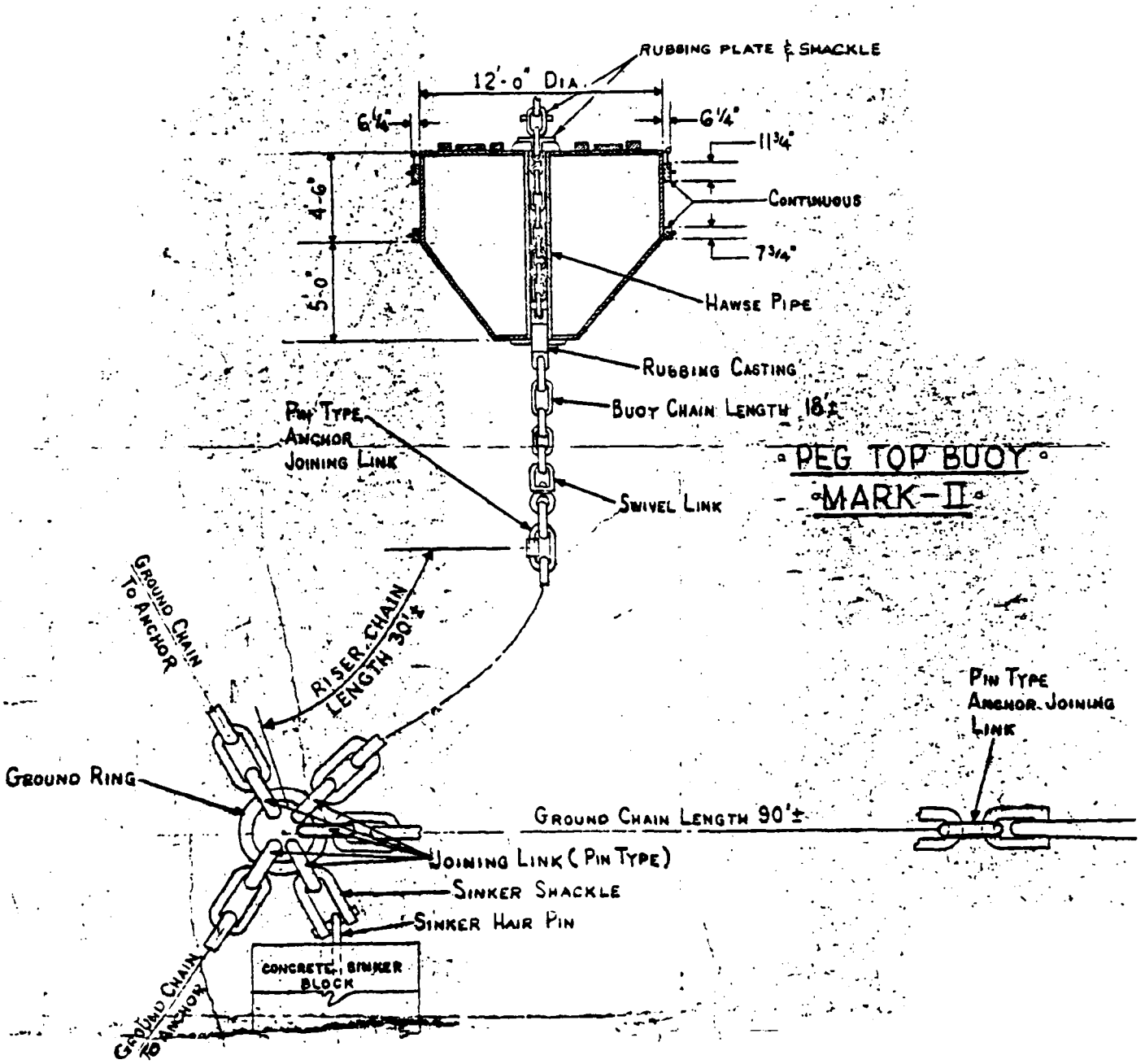


FIGURE 1. AS-BUILT DRAWING

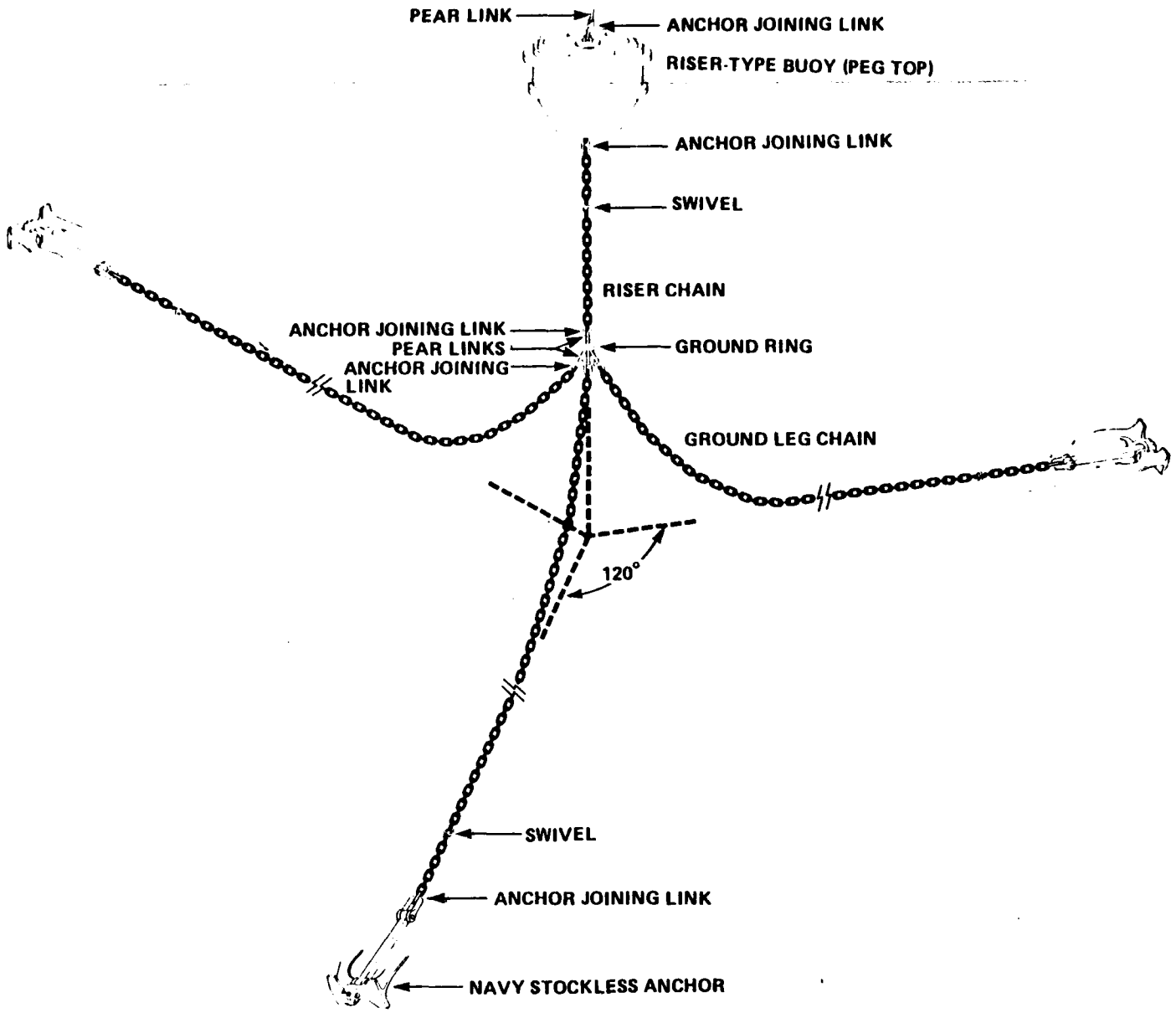


FIGURE 2. TYPICAL RISER-TYPE MOORING

4.2 Buoy. The geographic position of each buoy will be verified. In order to accomplish this, a transit will be used to sight each buoy from known positions ashore.

4.2.1 Buoy Upper Portion. The buoy shall be observed to determine its general condition. The size of the buoy (diameter and height) should be recorded along with its freeboard. Physical damage such as holes, dents, or listing shall be described. If the buoy is fiberglass coated, then the fiberglass should be inspected for cracks, wear, peeling, or rust-bleeding. A check will be made to see if the hatches have been fiberglassed over. If the buoy has not been fiberglassed, then the paint will be checked for cracking, chipping, and peeling. Hatches, openings, and penetrations will be examined and broken parts and rust will be reported. Inspection check lists are contained in Annex B.

The buoy fenders and rubbing rails shall be checked for integrity and secure connection to the buoy.

Buoy top jewelry shall be identified and measured with calipers to find the overall outside dimensions and areas of most severe reduction in wire size. Methods for presetting calipers are contained in Annex A.

4.2.2 Buoy Lower Portion. Divers shall thoroughly inspect the buoy below the waterline. The thickness of marine growth shall be recorded, three one-foot-square areas shall be selected and cleared of growth without damaging the paint or fiberglass, and the condition of the paint or fiberglass will be noted. If the buoy is a riser-type with a hawse pipe, the presence and condition of the rubbing casting shall be recorded. If the buoy is cathodically protected, the condition, dimensions, and connection of anodes are to be noted. Then, electrical potential readings are to be taken with an underwater voltmeter at three locations on the buoy bottom.

4.2.3 Bottom Jewelry. On each mooring, the jewelry connecting the buoy to the riser shall be identified and measured with calipers. As with the topside jewelry, the overall dimensions and the smallest wire size of each type of link or shackle will be recorded.

4.3 Riser. Three consecutive double link measurements using pre-cut gauges will be made at both ends and near the center of the riser. Procedures for the use of pre-cut gauges are also contained in Annex A. The swivel and detachable links contained within the riser assembly shall be visually inspected and measured. As the divers swim down the riser, all chain links and other mooring hardware will be visually observed. Material suspected to be in worn or damaged condition will be investigated.

4.4 **Ground Ring.** The ground ring shall be examined for general and localized wear. Caliper measurements shall be made of both the wire size in the region of the most severe wear and across the inner diameter.

4.5 **Ground Legs.** Three consecutive double link measurements of each ground leg shall be taken every 45 feet. In those cases where the ground leg chain is slack and not in tension, three single link measurements shall be taken of each selected link as shown in Figure A-1 (Annex A). All connecting hardware including detachable links, anchor joining links, pear links, end links, swivels and shackles shall be identified and measured with calipers. Worn hardware and unusual chain joining practices shall be recorded and photographed.

The legs shall be labeled A, B, and C clockwise from magnetic north and their orientation (determined by the diver's compass) sketched as in Figure 3.

In addition, the divers will survey each ground leg of each of the five moorings using an inclinometer and a depth gauge in order to establish ground leg catenary profiles. The catenary angle will be measured at each ten feet of depth, as shown in Figure 4, between the ground ring and the mud line. A pop float will be attached to the ground leg chain where it meets the bottom (and the water depth recorded) so that topside personnel can measure the horizontal distance between the buoy and the point at which the ground leg reaches the bottom. The EIC will also determine the height of the tide at the time these measurements and the wind speed and direction are being taken. This data will determine the catenary profile of each ground leg.

4.6 **Anchors.** If an anchor is located, a pop float shall be attached to it so that the relative positions of the anchor from the mooring buoy can be observed from the surface. The anchor's position shall be recorded. The hardware connecting an anchor to its ground leg will be measured by calipers and the wire diameters recorded.

4.7 **Photography**

4.7.1 **Topside.** Topside photography and ashore photographs are the responsibility of the Engineer-in-Charge.

Photographs will be taken of each buoy showing its general condition. Photographs of the topside jewelry and damaged buoy components will be taken as deemed appropriate by the EIC.

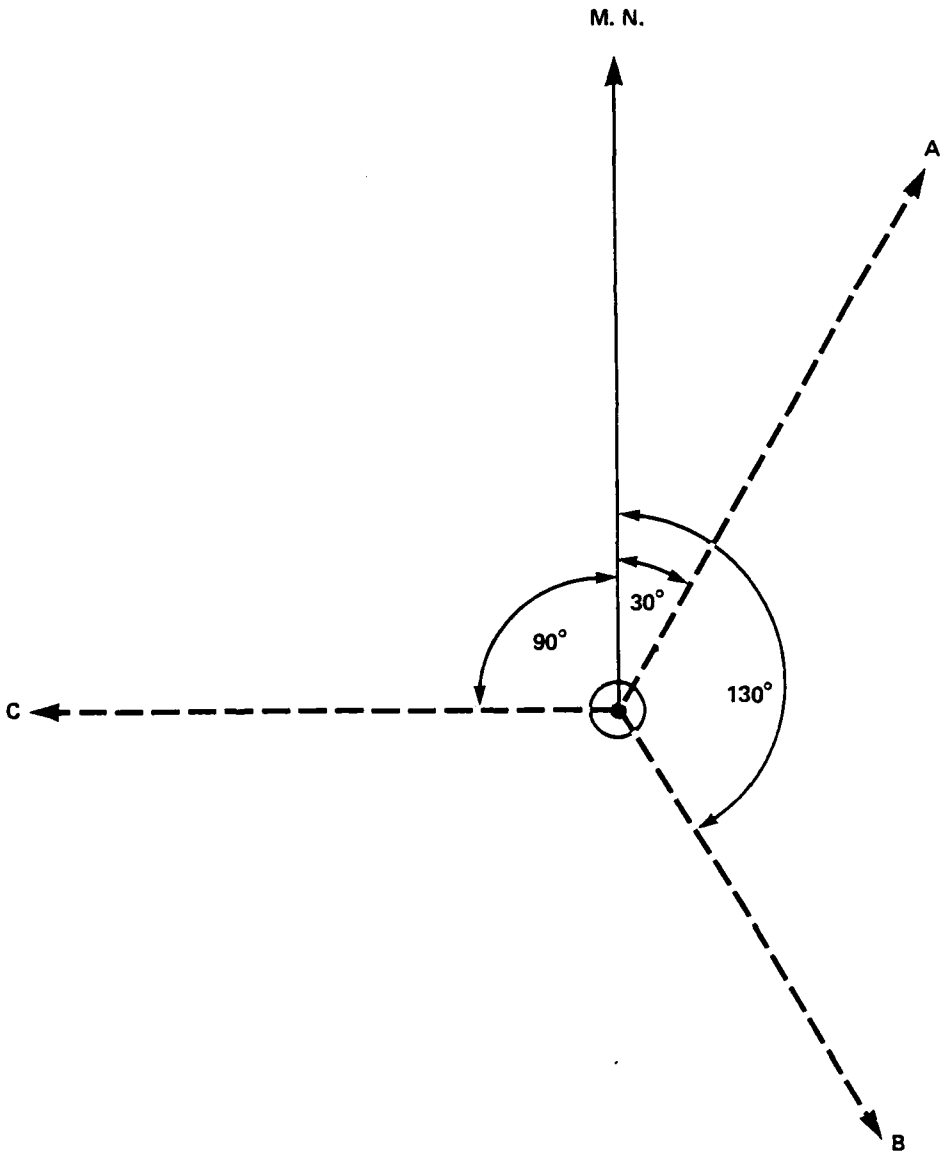


FIGURE 3. MAGNETIC BEARING OF GROUND LEGS

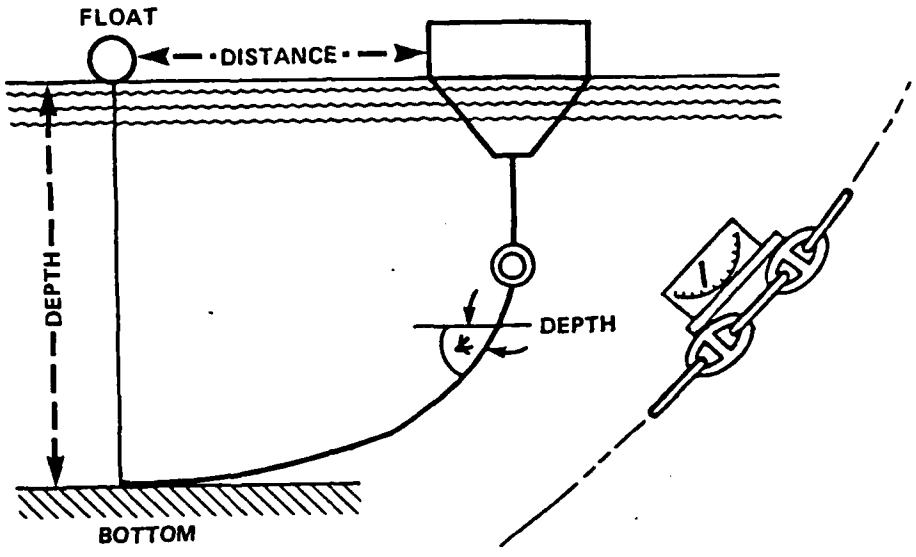


FIGURE 4. DETERMINING CATENARY PROFILES

Photographs will be taken of ashore spare mooring material inventories and construction equipment as deemed necessary.

4.7.2 Underwater. Underwater photography shall be the responsibility of the dive team. Buoy bottoms, bottom jewelry, worn links, swivels, ground rings, and other hardware shall be photographed wherever required to support material conditions and when environmentally feasible. Photographs shall include clear annotation as to the location of the hardware being photographed.

4.8 Cathodic Protection. Any moorings found to have cathodic protection will be inspected using the following procedures.

The underwater voltmeter will be used (after on-site calibration by the dive team) to probe the chain every 5 feet commencing with the buoy and bottom jewelry and continuing until the anchor is reached or the chain disappears into the bottom. All potential measurements will be recorded in the "Comments" column of Table B-2. Before cleaning, divers will photograph each anode and record the thickness, type and accumulation of the coating. Several anodes should be brushed to remove the oxidation

and the length, width and depth of the remaining zinc measured and photographed. Anodes in poor condition should be measured, reported and photographed.

5.0 DOCUMENTATION

The Engineer-in-Charge will document the inspection procedures used and record the data obtained by the dive team. He may require additional or alternative inspection procedures as deemed necessary during the course of the inspection. He will maintain a time log of events occurring during the inspection, and the master inspection form. In addition, the EIC must be prepared to debrief each diver, upon his return to the surface, in order to gain immediate knowledge of what the diver observed. The information obtained from the divers will be recorded, and this data will subsequently be the basis for the development of the moorings as-built configuration and for the preparation of the Fleet Mooring Inspection Report, which will contain the results of the inspection and recommendations for corrective maintenance actions.

While on site, the EIC will investigate the availability and cost of local mooring maintenance support. In addition he will conduct a cursory inspection of any on-shore Fleet Mooring Inventory (FMI) used for maintenance and repair or ready reserve. The type, size, quantity and general condition of the inventory shall be reported.

6.0 MEETINGS/BRIEFINGS

Upon arrival on site, the Engineer-in-Charge will conduct a pre-dive briefing to familiarize diving personnel with the mooring inspection procedures and to advise them of possible modifications to this inspection plan. In addition, the EIC will give a post-inspection debriefing to advise station personnel of the preliminary inspection findings.

7.0 LOGISTICS

7.1 UCT ONE. The following equipment will be provided by the divers in support of this inspection:

- Arrangements for messing, berthing, and transportation of diver personnel
- Acquisition of a dive platform/boat
- All diving support equipment

- Measuring aids

  - Inclinometer
  - 100' tape measures for use underwater
  - Scales 1, 2, and 3 feet with large numbers suitable for underwater photo documentation
  - Accurate depth gauges
  - Marker tags to relocate or mark chain links or accessories
  - Calipers (24 inch minimum)
  - Go/no-go guages

- Survey equipment

  - Compass (diver's)
  - Survey buoys with line (pop floats)
  - Underwater voltmeters

- Surveying transits for establishing mooring buoy locations.

- Two Underwater still cameras (35mm) with film (color and B & W) and flash with spare batteries

- Cleaning equipment – Hand tools including wire brushes, chipping hammers, and sharp chisels. Water blaster with water or hydraulic power supply and brush tool.

7.2 **CHESNAVFACENGCOM.** The CHESNAVFACENGCOM Engineer-in-Charge will provide the following:

- Inspection plan
- Data sheets and forms
- 35mm surface camera and film
- Drafting supplies, graph paper, scales
- Calculator
- Pre-dive briefing data
- DM-26

ANNEX A

MEASURING DEVICES AND THEIR USE

ANNEX A

1.0 MEASURING DEVICES AND THEIR USE

Tables A-1 and A-2 outline the 80 and 90 percent measurements for mooring components. These tables are based on the standard sizes of mooring material listed in DM-26 and can be used to preset calipers before measuring various items. For example, a class BB riser type mooring will require calipers set to 3.15" (90%) and 2.80" (80%) for single link measurements on the riser; 6.30" (90%) and 5.60" (80%) for double link on the riser; 2.25" and 2.0" for single link on the ground legs; 4.50" and 4.00" for double link on the ground legs; and for the ground ring 5.85" and 5.20".

The preferred measuring devices, however, are back-to-back 80 and 90 percent "go-no go" gauges. These gauges simplify the diver's job in that, unlike calipers, they cannot be knocked out of adjustment underwater, and they do not have to be checked and reset between dives. Figure A-1 contains the drawings and data required to fabricate these gauges. Although these gauges are a quick and efficient way of sampling the wire size of chain links and some jewelry, the divers still have to carry calipers to measure ground rings and chain connecting links.

The locations for measuring chain links are shown in Figure A-1.

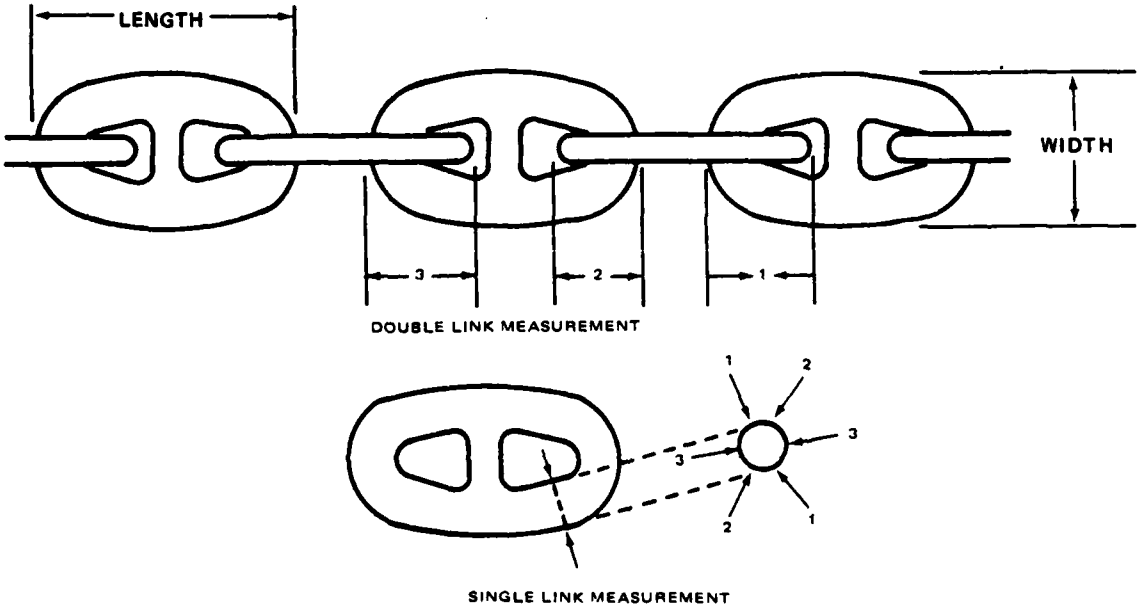


FIGURE A-1. LOCATIONS FOR TAKING CHAIN LINK MEASUREMENTS

TABLE A-1. SINGLE LINK MEASUREMENTS FOR COMPONENTS OF RISER-TYPE MOORINGS (DOUBLE VALUES FOR DOUBLE LINK MEASUREMENTS)

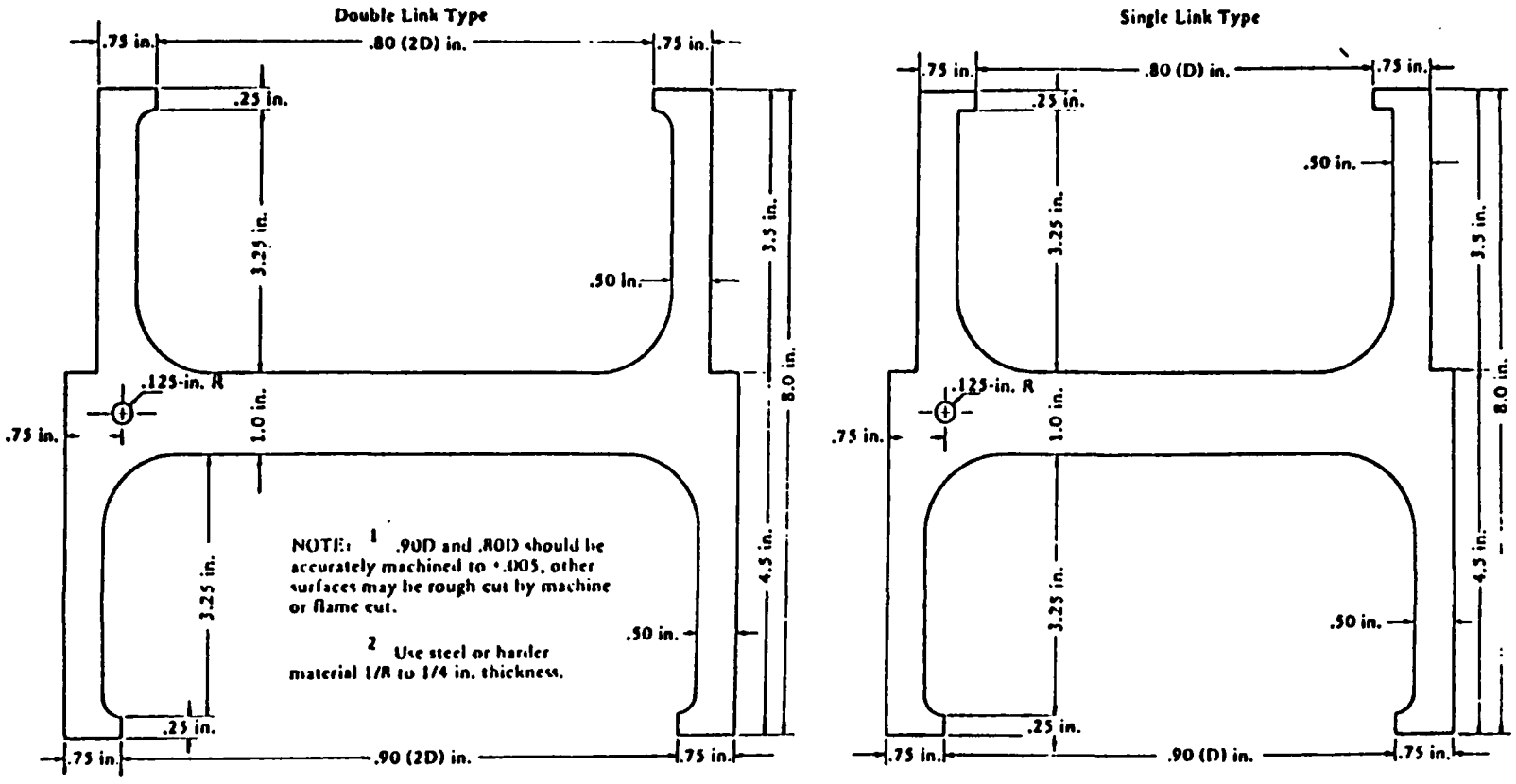
Class Mooring	Percent Remaining	Top of Buoy			Riser Chain	Ground Ring			Ground Tackle		Anchor[2]	
		F-Shackle	End Link	AJL[1]		AJL[1]	Ring	Spider	Chain[3]	AJL[1]	Stockless w/Stabilizer	LWT
A-A	100	5 3/8	4¼	4"	4	4"	6½	4 3	2 3/4	2 3/4"		
	90	4.838	3.285	type	3.6	type	5.85	3.6 2.7	2.475	type	25,000	-
	80	4.3	2.92		3.2		5.2	3.2 2.4	2.2			
B-B	100	4 15/16	3 15/16	3½"	3½	3½"	6½	4 3	2½	2½"		
	90	4.44	3.544	type	3.15	type	5.85	3.6 2.7	2.25	type	20,000	13,000
	80	3.75	3.15		2.8		5.2	3.2 2.4	2.0			
C-C	100	4 15/16	3 15/16	3½"	3½	3½"	6½	4 3	2¼	2¼"		
	90	4.44	3.544	type	3.15	type	5.85	3.6 2.7	2.025	type	18,000	10,000
	80	3.95	3.15		2.8		5.2	3.2 2.4	1.8			
D-D	100	4 3/16	3 3/4	3"	3	3"	6		3	3"		
	90	3.769	3.375	type	2.7	type	5.4	-	2.7	type	30,000	-
	80	3.35	3		2.4		4.8		2.4			
A	100	3 7/8	3 3/8	2 3/4"	2 3/4	2 3/4"	5½		2 3/4	2 3/4"		
	90	3.488	3.038	type	2.475	type	4.95	-	2.475	type	25,000	-
	80	3.1	2.7		2.2		4.4		2.2			
B	100	3½	3 1/8	2½"	2½	2½"	4 3/4		2½	2½"		
	90	3.15	2.813	type	2.25	type	4.275	-	2.25	type	20,000	13,000
	80	2.8	2.5		2.0		3.8					
C	100	3 1/8	2 3/4	2¼"	2¼	2¼"	4½		2¼	2¼"		
	90	2.813	2.813	type	2.025	type	4.05	-	2.025	type	10,000	10,000
	80	2.5	2.5		1.8		3.6	-	1.8			
D	100	2 13/16	2½	2"	2	2"	4		2	2"		
	90	2.531	2.25	type	1.8	type	3.6		1.8	type	13,000	6,000
	80	2.25	2.0		1.6		3.2		1.6			
E	100	2 7/16	2¼	1 3/4"	1 3/4	1 3/4"	3½		1 3/4	1 3/4"		
	90	2.174	2.025	type	1.575	type	3 15	-	1.575	type	9,000	4,000
	80	1.95	1.8		1.4		2.8		1.4			
F	100	1 3/4	1 3/4	1½"	1¼	1½"	2 3/4		1¼	1½"		
	90	1.575	1.575	type	1.125	type	2.813	-	1.125	type	5,000	2,000
	80	1.4	1.4		1.0		2.5		1.0			
G	100	1 1/16	.1	3/4"	3/4	3/4"	1 7/8		3/4	1"		
	90	.956	.9	type	.675	type	1.688	-	.675	type	3,000	300
	80	.85	.8		.6		1.5		.6			

1. AJL measurement vary according to manufacturer, see DM-26
2. Assumes firm sand bottom
3. Assumes cast steel chain

TABLE A-2. SINGLE LINK MEASUREMENTS FOR COMPONENTS OF TELEPHONE-TYPE MOORINGS (DOUBLE VALUES FOR DOUBLE LINK MEASUREMENTS)

Class Mooring	Percent Remaining	Top of Buoy		Buoy-to-Ground Tackle				Ground Tackle		Anchor[2]	
		End Link	AJL[1]	D/F-Shackle	AJL[1]	Spider		AJL[1]	Chain	Stocktless/Stabilizer	LWT
A-A	100	4¾	4"	4 11/16	4"	4	3	2 3/4"	2 3/4		
	90	3.285	type	4.219	type	3.6	2.7	type	2.475	25,000	-
	80	2.92		3.75		3.2	2.4		2.2		
B-B	100	4¾	4"	4 11/16	3½"	4	3	2½"	2¾		
	90	3.285	type	4.219	type	3.6	2.7	type	2.25	20,000	13,000
	80	2.92		3.75		3.2	2.4		2.0		
C-C	100	4¾	4"	4 11/16	3½"	4	3	2¼"	2¼		
	90	3.285	type	4.219	type	3.6	2.7	type	2.025	18,000	10,000
	80	2.92		3.75		3.2	2.4		1.8		
D-D	100	4¾	4"	4 11/16	3"			3"	3		
	90	3.285	type	4.219	type			type	2.7	30,000	-
	80	2.92		3.75					2.4		
A	100	3 3/8	3½"	3 7/8	2 3/4"			2 3/4"	2 3/4		
	90	3.038	type	3.400	type			type	2.475	25,000	-
	80	2.7		3.1					2.2		
B	100	3 3/8	3½"	3½	2½"			2½"	2¾		
	90	3.038	type	3.15	type			type	2.25	20,000	13,000
	80	2.7		2.8					2.0		
C	100	3 3/8	3½"	3 1/8	2½"			2½"	2¼		
	90	3.038	type	2.813	type			type	2.025	18,000	10,000
	80	2.7		2.5					1.8		
D	100	3 3/8	3½"	2 13/16	2"			2"	2		
	90	3.038	type	2.531	type			type	1.8	13,000	6,000
	80	2.7		2.25					1.6		

1. AJL measurements vary according to manufacturer, see DM-26
2. Assumes firm sand bottom
3. Assumes cast steel chain



D"	Single Link		Double Link		D"	Single Link		Double Link		D"	Single Link		Double Link	
	.90D	.80D	.90(2D)	.80(2D)		.80D	.80D	.90(2D)	.80(2D)		.90D	.80D	.90(2D)	.80(2D)
6-1/2	(1) 5.85	5.20	–	–	3-1/2	(6) 3.15	2.80	(17) 6.30	5.60	2	(11) 1.80	1.60	(22) 3.60	3.20
6	(2) 5.40	4.80	–	–	3	(7) 2.70	2.40	(18) 5.40	4.80	1-7/8	(12) 1.69	1.50	--	
5-1/2	(3) 4.95	4.40	--	–	2-3/4	(8) 2.48	2.20	(19) 4.96	4.40	1-3/4	(13) 1.58	1.40	(23) 3.06	2.80
4-1/2	(4) 4.05	3.60	-	--	2-1/2	(9) 2.25	2.00	(20) 4.50	4.00	1-1/2	(14) 1.35	1.20	(24) 2.70	2.40
4	(5) 3.60	3.20	(16) 7.20	6.40	2-1/4	(10) 2.03	1.80	(21) 4.06	3.60	1-1/4	(15) 1.125	1.00		

FIGURE A-2. 10 PERCENT "GO-NO-GO" GAUGES

ANNEX B

SAMPLE INSPECTION FORMS

Tables B-1, B-2, and B-3 depict three forms the EIC and divers may use to record measurements and as-built data.

TABLE B-1

MOORING NO.: _____ CLASS: _____ LOCATION: _____ LAT: _____ LONG: _____

WATER DEPTH: _____ ANCHOR SIZE/TYPE: _____ BUOY TYPE: _____

BOTTOM TYPE: ☐ SAND ☐ MUD ☐ CLAY ☐ CORAL ☐ ROCK Visibility _____ D = depth NI = not inspected, inaccessible

COMPONENTS		NI	CONDITION							COMMENT
			NEW	SINGLE LINK %			DOUBLE LINK %			D	
				90+	80+	80-	90+	80+	80-		
BUOY HARDWARE											
RISER	NEAR BUOY										
	MIDDLE										
	NEAR GRD RG										
GROUND RING											
GROUND LEG NO. A	UPPER END										
	MIDDLE										
	ENTERS BOTTOM										
GROUND LEG NO. B	UPPER END										
	MIDDLE										
	ENTERS BOTTOM										
GROUND LEG NO. C	UPPER END										
	MIDDLE										
	ENTERS BOTTOM										
GROUND LEG NO. D	UPPER END										
	MIDDLE										
	LNTERS BOTTOM										

DATE: _____ ENGINEER IN-CHARGE: _____ DIVERS: _____

TABLE B-2. CATENARY DATA

MOORING NO: _____ CLASS: _____ LOCATION: _____

DATE: _____ ENGINEER-IN-CHARGE: _____ DIVERS: _____

LEG A		LEG B		LEG C	
DEPTH	ANGLE	DEPTH	ANGLE	DEPTH	ANGLE

NOTE: Take readings at specified depths.

MOORING DATA SUMMARY FOR PREPARATION OF AS-BUILTS

MOORING# _____ CLASS _____ LOCATION _____ DATE _____

BOTTOM TYPE _____ WATER DEPTH _____ MOORING CONDITION _____

ENGINEER-IN-CHARGE _____ DIVERS _____

BUOY TYPE
- DIMENSIONS _____
- CONDITION _____
- TOP HARDWARE _____
- BOTTOM HARDWARE _____

RISER LENGTH
- TYPE CHAIN _____
- LINK WIDTH _____
- WIRE DIAM. _____

GROUND RING LOC.
- OUTER DIAM. _____
- WIRE DIAM. _____
- CONDITION _____

LEG A LENGTH
- EXPOSED LENGTH _____
- TYPE CHAIN _____
- LINK WIDTH _____
- WIRE DIAM. _____

LEG B LENGTH
- EXPOSED LENGTH _____
- TYPE CHAIN _____
- LINK WIDTH _____
- WIRE DIAM. _____

LEG C LENGTH
- EXPOSED LENGTH _____
- TYPE CHAIN _____
- LINK WIDTH _____
- WIRE DIAM. _____

LEG D LENGTH
- EXPOSED LENGTH _____
- TYPE CHAIN _____
- LINK WIDTH _____
- WIRE DIAM. _____

RISER CONNECTIONS _____

LEG CONNECTIONS _____

OTHER _____

END

FILMED

6-86

DTIC